BELLCOMM, INC.

SUBJECT: Review of AS-201 & AS-501 Inter-Center Interface Control Documents - Case 201

DATE: August 30, 1965

FROM: W. T. Botner
J. D. Richey
C. M. Volk
H. A. Wente

ABSTRACT

During recent months the Centers, the Panels, and the Panel Review Board (PRB) have placed additional emphasis on the identification, preparation and improvement of inter-Center Interface Control Documents (ICD's). This effort has pointed out the need for a definition of criteria for material to be included in ICD's and an estimation of the probable coverage and quality of AS-501 ICD's.

This memorandum presents a proposed definition and set of criteria for Apollo inter-Center ICD's, and the results of a review and evaluation of the current AS-201 and AS-501 ICD's using the proposed definition.

In general the ICD's examined show improvement since the April 1965 ICD review. Extrapolation of the present trend indicates that the AS-501 ICD's will be satisfactory.

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MEMORANDUM FOR FILE

Introduction

During recent months the Centers, the Panels, and the Panel Review Board (PRB) have placed additional emphasis on the identification, preparation and improvement of inter-Center Interface Control Documents (ICD's). This effort has pointed out a need to define criteria for material to be covered by ICD's. Initially* an ICD was considered an appropriate vehicle for documenting all inter-Center interface agreements. Today there is a general concensus that restricting ICD coverage to physical, functional, environmental and human factors interface characteristics, together with any procedural-operational constraints and requirements which affect facility, equipment, and computer software design or assembly results in a more workable ICD definition. Selected Apollo inter-Center ICD's were reviewed for conformity with a proposed (restricted) ICD definition. This memorandum presents the results of the review and a concurrent assessment and projection of coverage and quality trends applicable to AS-501 ICD's.

Review Procedure

A proposed ICD definition and criteria (Attachment A) suitable for inclusion in the PRB charter was developed. Available ICD's for AS-201 and AS-501 (see Attachment B) were examined for coverage in accordance with the proposed ICD definition and the applicable PRB Panel scope statement. A number of ICD's and Interface Revision Notices (IRN's) could not be obtained from the Repository in time to permit review. Comments on individual ICD's and general evaluation of each Panel's ICD efforts are contained in Attachments C through I.**

Summary of Review

The observations summarized below are the judgments of the authors and for the most part have not been reviewed with cognizant Center personnel.

[redacted]

*Prior to PRB 65-3.

**ICD's from the Launch Operations Panel were excluded from this review pending completion of the August 1965 KSC-MSC-MSFC review of LOP ICD's.

Crew Safety Panel

The ICD's reviewed present information that is required by the attached ICD definition. There was no nonessential information presented. These ICD's conform to the previous concept of information required in an ICD. The status of the Crew Safety ICD's has not changed significantly since the April 1965 review of AS-201 ICD's. The quality of the ICD's was considered satisfactory at that time. ICD No. 40M37530, "Description of Saturn AS-201 and Apollo S/C-009 Emergency Detection System" has become available since the review and reflects continued quality. If the present trend continues, the EDS interfaces for AS-501 should be satisfactorily defined.

ICD No. 40M37530 could be improved by including a list of Electrical Panel ICD's that contain EDS information. ICD No. 40M37530 states that some EDS electrical connections to other systems are omitted. These connections should be reexamined to insure that pertinent interface information has not been overlooked.

Electrical Panel

The content and coverage of inter-Center interfaces documentation, currently identified by the Electrical Panel, is in general compliance with the definition of inter-Center ICD's as defined in this review. Several of the issued ICD's, however, present informational and procedural data which do not necessarily affect the design of equipment or facilities and may be considered as nonessential to the ICD's. These ICD's conform to the initial definition of ICD's, which accepts procedural agreements as ICD material.

The current ICD's identified by the Electrical Panel contain significant new material as compared to those identified during our April 1965 review. The quality of the ICD's reviewed still remains high. The trend of the Panel's effort in identification and documentation of interfaces is toward improvement of coverage and quality of ICD's.

Based upon the current trend of Electrical Panel documentation efforts, and comparing their output against the definition of ICD's presented herein, satisfactory documentation of AS-500 series interfaces can be expected. It would be desirable, however, if Electrical Panel ICD's covering similar subject material (e.g., connector wiring lists) could be presented in one standardized format.

Flight Operations Panel

The Flight Operations Panel has not released any ICD's. One ICD has been identified which will cover only Panel agreements pertaining to mission simulation.

Based on the ICD definition in Attachment A, the planned ICD coverage by the Flight Operations Panel on AS-501 will not be entirely satisfactory. Specifically, documentation of space vehicle data requirements and data and information flow requirements among the three Centers is needed.

Flight Evaluation Panel

The Flight Evaluation Panel has not released any ICD's, but has identified ICD's for AS-201 and AS-501 entitled "Post Flight Trajectory." From a review of the proposed format of the ICD's and a telephone conversation with Dr. F. A. Speer, MSFC Co-Chairman of the Panel, it was learned that the ICD's do not document any agreements that directly affect the design of hardware. The ICD media is being used for the documentation of procedures for post-flight evaluation which could be recorded in other inter-Center documents of agreement.

Flight Mechanics Panel

The content of the Flight Mechanics Panel (FMP) ICD's generally satisfy the attached definition of an ICD. The ICD's include nonessential informational material and appear to be complete documentation of all Panel agreements. Although no significant amount of new material was included in the ICD's since the AS-201 FMP ICD was reviewed in April, the quality of ICD content has improved. With the resolution and documentation of the present structural design load compatibility problem, FMP ICD's should be complete. The format of the current AS-501 FMP ICD follows that for AS-201 and thus the later issues of the AS-501 FMP ICD can be expected to be as comprehensive as the current AS-201 FMP ICD (Revision A).

Because the FMP anticipates releasing at least two revisions to their basic flight mechanics ICD, it is recommended that each issue be identified separately in the ICD Log.

Instrumentation/Communication Panel

The content and coverage of inter-Center interface documentation, by the Instrumentation/Communications Panel, when combined with other Program documents (PIRD's, EIRD's, etc), is in general compliance with the definition of inter-Center ICD's as defined in this review. Deviations from this guideline have been noted in the frequency analysis document, ICD No. 13M60002, which is identified as a historical document only and does not uniquely present data which will affect the

design of equipment or facilities. In addition, the S/C to L/V ICD No. 13M62011 contains informational and procedural data, and conforms to the initial definition of ICD's which accepts procedural agreements as ICD material.

ICD's identified by the I/C Panel* contain significant new material as compared to those available during our April 1965 review. The trend of the Panel's effort in identification and documentation of interfaces is towards improvement of coverage and quality of ICD's.

Based upon the current trend of I/C Panel documentation efforts, and comparing their output against the definition of ICD's presented herein, satisfactory documentation of AS-500 series interfaces can be expected. It should be noted that possible conflict could occur between I/C ICD's and Electrical Panel agreements, PIRD's, EIRD's, and contractor documentation if rigid change control is not practiced.

Mechanical Panel

The available Mechanical Integration Panel ICD's do not cover the material as per the ICD definition in Attachment A and do not contain nonessential information. Also, some inter-Center agreements now deleted need to be included.

Since the ICD review of April 1965, the ICD's examined included a modest amount of new material in the form of IRN's and showed an improvement in quality.

Information obtained from the MSC Panel Co-Chairman in a telephone conversation August 28 revealed that the coverage and quality discrepancies of the ICD's are being rectified so both the AS-201 and AS501 ICD's generated by the Mechanical Integration Panel should show substantial improvement.

W. T. Botner
J. D. Richey
C. M. Volk
H. A. Wente

WTB
JDR
2033-CMV-lmw
HAW

Attachments and Copy to
(see next page)

*ICD's identified on August 3, 1965, per telephone conversation with H. Golden, MSFC Panel Co-Chairman.

BA-149A (8-64)

Attached
Attachments A through I

Copy to
Messrs. C. Bidgood
J. P. Downs
J. J. Hibbert
J. A. Hornbeck
B. Kaskey
P. R. Knaff
J. Z. Menard
C. R. Moster
T. L. Powers
I. M. Ross
P. F. Sennewald
R. V. Sperry
T. H. Thompson
G. B. Troussoff
R. L. Wagner
Central Files
Department 1023
Library

DEFINITION & CRITERIA FOR APOLLO INTER-CENTER INTERFACE CONTROL DOCUMENTS

(Proposed)

1.0 GENERAL

Apollo project interface characteristics, not defined by Apollo Program Office requirements, shall be established by the inter-Center Coordination Panels acting within the scope of their charters. These agreements and any subsequent revisions shall be formally defined, documented in, and controlled by inter-Center Interface Control Documents (ICD's). One or more ICD's, as appropriate, shall be prepared to define each interface.

2.0 INFORMATION WHICH MUST BE COVERED BY ICD's

2.1 Design Criteria and Design Requirements

Inter-Center agreements establishing technical requirements for design of interfacing hardware and software including operational-procedural constraints, requirements and technical data affecting facility, equipment and computer software design and assembly.

2.2 Physical and Functional Designs

Drawings, lists and associated documentation defining and describing the actual interface to which hardware and software will be designed, (e.g., mechanical, electrical, etc.).

3.0 INFORMATION WHICH NEED NOT BE COVERED BY ICD's

3.1 Operation and procedural agreements that do not affect hardware and software design, and which, because of normal and frequent modification up until time of launch, cannot be controlled practically by the ICD system (e.g., specific operational flight trajectories, telemetry channel assignments, etc.).

3.2 Data supporting interface agreements covered by Paragraph 2.0 above (e.g., frequency interference study).

4.0 STATUS OF ICD's

4.1 Approved ICD's, and revisions thereto, are the governing inter-Center interface control media and are binding upon the Centers involved. ICD requirements shall be relfected or referenced in applicalbe project, system or CEI specifications and controlled to insure multi-Center consideration and approval of changes.

Attachment B

AS-201 & 501
INTERFACE CONTROL DOCUMENT REVIEW

Panel	CS	EI	FC	FE	FM	IC	LO	MI
AS-201								
Identified ICD's	2	7	1	1	1	3	68	6
ICD's Reviewed	2	6	0	0	1	3	-	6
AS-501								
Identified ICD's	1	7	1	1	1	2	88	5
ICD's Reviewed	1	3	-	-	1	0	-	3

CREW SAFETY PANEL

Scope of ICD Content

This Panel determines space vehicle emergency conditions and the required crew safety action prior to and during flight through spacecraft separation. It is specifically concerned with:

1. The emergency detection system and its design specification for the L/V. This includes parameters to be monitored, type of signals and displays and resulting manual or automatic action.

2. Crew safety system interface problems between the L/V and the S/C.

3. S/C emergency conditions affecting the L/V flight.

Comments on Released ICD's

ICD No. 13M65000, "Design Criteria for Saturn-IB On-Board Emergency Detection System (EDS)".

ICD No. 13M65001, "Design Criteria for Saturn V On-Board Emergency Detection System (EDS)".

These ICD's are identical in that they call out the functional requirements of the EDS. They described: parameters that are sensed, warning indicators, engine shut downs and abort sequences that are functions of the EDS. The ICD's accomplish their stated purpose which is the documentation of the on-board EDS design criteria. Paragraphs 1 through 1.3 of ICD No. 13M65001 were not reviewed because they were not included in the ICD copy received from the Repository.

ICD No. 40M37530, "Description of Saturn SA-201 and Apollo S/C-009 Emergency Detection System".

1. This ICD references ICD No. 13M65000, "Design Criteria for Saturn-IB On-Board Emergency Detection System (EDS)" as the source for its definition of "special requirements". EDS interfaces between modules and stages are defined in functional terms only. Statements are made that "Detailed interface information is contained in the interface documents . The document drawing number and other pertinent information may be obtained from the Inter-Center Interface Control Document Log." The ICD Log shows ICD No. 40M98859, "EDS Checkout Schematics" issued by the

Electrical Panel as the only other AS-201 ICD pertaining to the EDS. The ICD Log does not reflect any ICD titles that describe the physical and/or operational characteristics of the EDS. The title of ICD No. 40M37530 is shown in the Log as "DES of SAT SA-201 + APOLLO S/C-009", which in no way implies that it describes anything about the EDS.

2. The functional description of the EDS is incomplete in that all connections from other systems into the EDS circuits are not described.

ICD Activity Pending

No ICD activity affecting the above comments has been reported.

General Conclusions

The ICD's reviewed present information that is required by the attached ICD definition. There was no nonessential information presented. These ICD's conform to the previous concept of information required in an ICD. The status of the Crew Safety ICD's has not changed significantly since the April 1965 review of AS-201 ICD's. The quality of the ICD's was considered satisfactory at that time. ICD No. 40M37530, "Description of Saturn SA-201 and Apollo S/C-009 Emergency Detection System" has become available since the review and reflects continued quality. If the present trend continues the EDS interfaces for AS-501 should be satisfactorily defined.

ICD No. 40M37530 could be improved by including a list of Electrical Panel ICD's that contain EDS information. ICD No. 40M37530 states that some EDS electrical connections to other systems are omitted. These connections should be reexamined to insure that pertinent interface information has not been overlooked.

ELECTRICAL PANEL

Scope of ICD Content

The responsibilities of the Electrical Panel as defined in the Panel charter indicates that the following should be covered in inter-Center ICD's:

1. Define, analyze, and implement the requirements for electrical system design compatibility in view of the overall system.

2. Define, analyze, and implement the requirements for electrical systems design compatibility in view of systems checkout during stage mating, final checkout and launching, and streamline the design of the check-out system to fit into the overall scope of operations.

3. Define electrical interface requirements between launch vehicle and spacecraft.

4. Establish requirements for proper utilization of electrical equipment for checkout and launch operations.

5. Define range safety electrical design requirements connected with the overall electrical system.

Comments on Released ICD's

ICD No. 16331-63A107350, "ACE-S/C-L/V Computer Interface Unit Cabinet Assembly".

This ICD describes the electrical interface between the ACE-S/C-L/V Computer Interface Unit Cabinet assembly and blockhouse.

1. The ICD is satisfactory in content and quality for use as a guide in the preparation of AS-500 series ICD's. However, a standard format for Electrical Panel ICD's of similar subject matter should be developed.

2. The following is recommended to enhance ICD clarity:

   a. The connector mechanical interface drawing should be included or noted as a referenced document.

   b. Schematic line drawings of the connector interfaces should be included or referenced.

c. A standard format for connector/electrical connection interface ICD's should be established.

d. The Table of Contents should be corrected.

ICD No. 16311-63A107393, "Software ICD, ACE-S/C-L/V Computer Interface Unit Cabinet Assembly".

This ICD describes the mode of communication between the ACE-S/C and the L/V computer system.

1. The Table of Contents should be corrected.

2. There is much procedural information detailed in the ICD. Since this software ICD is unique, the inclusion of such procedural data may be necessary, and the ICD may be the proper vehicle for its documentation.

ICD No. 40M05400, "Saturn-IB L/V ESE to S/C ESE".

ICD No. 40M05403, "Saturn-IB L/V ESE to Propellant Systems".

These ICD's describe the L/V ESE to the S/C ESE and the Propellant System interfaces.

1. These ICD's are satisfactory in content and quality for use as a guide in the preparation of AS-500 series ICD's. However, a standard format for Electrical Panel ICD's of similar subject matter should be developed.

2. The following is recommended to enhance ICD clarity:

   a. The connector mechanical interface drawings should be included as a referenced document.

   b. Schematic line drawings of the connector interface should be included or referenced.

   c. A standard format for connector/electrical connection interface ICD's should be established.

ICD No. 40M08859, "EDS Checkout Schematics".

This describes the AS-201 L/V to S/C-009 EDS checkout design. It is an informational and descriptive ICD that presents circuit schematics and relay functions for AS-201.

1. This ICD records only EDS circuit schematics and functional characteristics which may be required for system checkout. The inter-Center agreement unique to this document is not explicit.

2. Assuming that this ICD is intended to be primarily informational in nature and supplement other ICD's and Program documents, it is satisfactory in content and quality for use as a guide in the preparation of AS-500 series ICD's. A narrative description of the purpose of the ICD would enhance its clarity.

ICD No. 40M37505A, R-1, "Definition of Saturn SA-201 and Apollo S/C-009 Electrical Interface".

1. This ICD is satisfactory in content and quality for use as a guide in the preparation of AS-500 series ICD's. However, a standard format for Electrical Panel ICD's of similar subject matter should be developed.

2. The following is recommended to enhance ICD clarity:

   a. Schematic line drawings of the connector interfaces should be included or referenced.

   b. A standard format for connector/electrical connection interface ICD's should be established.

ICD No. 40M05405,* "Saturn-IB L/V ESE to Launch Equipment".

ICD No. 40M37517, "Definition of Saturn SA-501 and Apollo S/C-017 Electrical Interface".

This ICD defines the electrical interface between the AS-501 Instrument Unit and Apollo S/C-017.

1. The ICD is satisfactory in content and quality for use as a guide in the preparation of AS-500 series ICD's. However, a standard format for Electrical Panel ICD's of similar subject matter should be developed.

2. The following is recommended to enhance ICD clarity:

   a. Schematic line drawings for the connector interfaces should be included or referenced.

   b. A standard format for connector/electrical connection interface ICD's should be developed.

ICD Activity Pending

The ICD Log shows that all AS-201 identified Electrical Panel ICD's have been released.

*Not available from the Repository.

General Conclusions

The content and coverage of inter-Center interface documentation, currently identified by the Electrical Panel, is in general compliance with the definition of inter-Center ICD's as defined in this review. Several of the issued ICD's, however, present informational and procedural data which do not necessarily affect the design of equipment or facilities and may be considered as nonessential to the ICD's. These ICD's conform to the initial definition of ICD's, which accepts procedural agreements as ICD material.

The current ICD's identified by the Electrical Panel contain significant new material as compared to those identified during our April 1965 review. The quality of the ICD's reviewed still remains high. The trend of the Panel's effort in identification and documentation of interfaces is toward improvement of coverage and quality of ICD's.

Based upon the current trend of Electrical Panel documentation efforts, and comparing their output against the definition of ICD's presented herein, satisfactory documentation of AS-500 series interfaces can be expected. It would be desirable, however, if Electrical Panel ICD's covering similar subject material (e.g., connector wiring lists) were presented in one standardized format.

FLIGHT OPERATIONS PANEL

Scope of ICD Content

From an examination of the Flight Operations (FO) Panel charter, ICD coverage of the following can be expected:

1. Instrumentation or data requirements for maintaining status and performance of the space vehicle.
2. Data and information flow requirements between LCC, HOSC, and MSCC.
3. Flight operations simulation performance requirements.
4. Interfacing Center participation and support in mission operations.

Comments on Released ICD's

No ICD's have been released by the Panel.

ICD Activity Pending

The Simulation Sub-Panel is scheduled to release a "Launch Vehicle Flight Control Simulation Math Model" ICD for each mission four months prior to launch. No other ICD's have been identified by the FO Panel.

General Conclusions

The Flight Operations Panel has not released any ICD's. One ICD has been identified which will cover only Panel agreements pertaining to mission simulation.

Based on the ICD definition in Attachment A, the planned ICD coverage by the Flight Operations Panel on AS-501 will not be entirely satisfactory. Specifically, documentation of space vehicle data requirements and data and information flow requirements among the three Centers are needed.

FLIGHT EVALUATION PANEL

Scope of ICD Content

The scope statement for this Panel does not define any responsibilities that require the issuance of ICD's that directly affect hardware design. Panel responsibilities that might cause the issuance of procedural ICD's or the placing of requirements on other Coordination Panels that would indirectly influence the design of hardware are as follows:

1. Define coordinated and consistent evaluation procedures for both the launch vehicle and the spacecraft.

2. Develop procedures for adequate and timely exchange of selected raw and reduced data and/or results of analyses.

3. Evaluate all mutual problems of the flight instrumentation as they affect the flight evaluation and revise requirements.

4. Determine responsibilities for evaluation reports to be published separately, and/or jointly by KSC, MSC, and MSFC.

Comments on Released ICD's

No ICD's have been released by the Panel.

ICD Activity Pending

The Panel intends to issue one post-flight trajectory ICD for each flight. No other ICD's are contemplated at this time.

General Conclusions

The Flight Evaluation Panel has not released any ICD's but has identified ICD's for AS-201 and AS-501, entitled, "Post Flight Trajectory". From a review of the proposed format of the ICD's and a telephone conversation with Dr. F. A. Speer, MSFC Co-Chairman of the Panel, it was learned that the ICD's do not document any agreements that directly affect the design of hardware. The ICD media is being used for the documentation of procedures for post-flight evaluation which could be recorded in other inter-Center documents.

FLIGHT MECHANICS PANEL

Scope of ICD Content

Within the charter of the Flight Mechanics Panel, ICD coverage of the following can be expected:

1. Aerodynamics of the space vehicle, including static and dynamic aerodynamic stability characteristics, static and transient air loads distribution, and acoustic environment resulting from boundary layer and engine exhaust.

2. Basic design trajectory.

3. Configuration and performance characteristics.

4. Mission constraints.

5. Guidance and attitude control requirements, accuracy requirements, L/V-S/C guidance back-up requirements and guidance system influence on space vehicle performance and trajectories.

6. Structural design criteria including space vehicle dynamic and aero-elasticity characteristics.

Comments on Released ICD's

ICD No. 80M90201 Revision A,"Flight Mechanics, Dynamics, Guidance and Control Panel Interface Control Document".

1. Although the natural environment in M-D E8020.008B "Natural Environment and Physical Standards for the Apollo Program" is specified by the Apollo Program Specifications, the ICD for the most part reiterates the wind criteria of M-D E8020.008B. The ICD also references several documents that are the basis for the Natural Environment and Physical Standards rather than the Standards document itself. (Paragraph 2.1.1 and 12.1).

2. Data on transient and static air loads are shown as "to be supplied".

3. First stage pitch programming information is "to be supplied".

ICD No. 80M90501, "Flight Mechanics, Dyanmics, Guidance and Control Panel Interface Control Document".

1. Same as comment (1.) for ICD No. 80M90201, Revision A. In addition, the Apollo Program Specification calls for a launch capability in 95 percentile peak winds whereas the ICD specifies 99 percentile peak winds. (Paragraph 12.1.1.2).

2. The notation "to be supplied" is used in a number of areas in the ICD. This causes an uncertainty as to whether the ICD is incomplete because of possible failure of the Panel to meet commitments or that the requirements are scheduled for inclusion in a later revision.

ICD Activity Pending

AS-201 structural design load compatibility has recently been resolved between MSC and MSFC. Resolution of this problem will enable the completion of the ICD for AS-201 and probably will satisfy comment (2) and (3) for ICD No. 80M90201 Revision A.

General Conclusions

The content of the Flight Mechanics Panel (FMP) ICD's generally satisfy the attached definition of an ICD. The ICD's include nonessential informational material and appear to be a complete documentation of all Panel agreements. Although no significant amount of new material was included in the ICD's since the AS-201 FMP ICD was reviewed in April, the quality of ICD content has improved. With the resolution and documentation of the present structural design load compatibility problem, FMP ICD's should be complete. The format of the current AS-501 FMP ICD follows that for AS-201 and thus the later issues of the AS-501 FMP ICD can be expected to be as comprehensive as the current AS-201 FMP ICD (Revision A).

Because the FMP anticipates releasing at least two revisions to their basic flight mechanics ICD, it is recommended that each issue be identified separately in the inter-Center ICD Log.

INSTRUMENTATION/COMMUNICATION PANEL

Scope of ICD Content

The following general subjects are within the scope of the I/C Panel charter and would be considered for inclusion in inter-Center ICD's:

1. Establish space vehicle and respective ground instrumentation and communication systems compatibility.

2. Establish a frequency plan for minimizing radio frequency interference.

3. Determine frequency allocation.

Comments on Released ICD's

ICD No. 13M60002, "Saturn-IB Frequency Plan".

1. This ICD primarily serves to present a frequency interference study of the Saturn-IB launch vehicle. It also contains a summary frequency plan which was used as a basis for the study.

2. This ICD has been superceded by ICD No. 13M60003, "Saturn/Apollo Frequency Plan", but will continue to serve as a historical record of the frequency interference study.

ICD No. 13M60003, "Saturn/Apollo Frequency Plan, I&C Interfaces".

1. This ICD presents a frequency plan for AS-201 and other Apollo/Saturn 200 and 500 series missions. It supercedes ICD No. 13M60002. In this document, the transmitting and receiving frequencies to be utilized for the various space vehicle systems during Apollo/Saturn missions are clearly listed and their functions identified.

2. In Paragraph 2.2 "Precedence of Document", an additional statement should be included which clarifies precedence of the ICD over other Program documents (e.g., PIRD, Program Directives and Specification, etc.).

ICD No. 13M62011, R-1,* "Saturn Launch Vehicle SA-201 to Apollo Spacecraft AFRM-009 Instrumentation and Communications Interface".

*Not listed in current ICD Log.

1. Paragraph 1.0 - The interface shown in Figure 1 does not explicitly define the interface discussed.

2. Paragraph 2.1 - The control capability of the "Associated Interface Documents" and the division of responsibility noted is not stated explicitly.

3. Paragraph 2.3 - This paragraph is too general in its scope. It implies precedence over Program specifications and directives.

4. Paragraph 3.2.3 - A statement describing the reason for Panel control of the C-Band antenna should be provided.

5. Paragraph 4.1, 4.2, 4.3 - The following information should also be included in the ICD to describe the interface:

   a. Line drawing of connector interface.

   b. Reference to mechanical connector interface drawings.

   c. Signal characteristics.

6. Appendix B - This list does not agree exactly with the S-IB PIRD, e.g., the S/C VHF-TM transmit frequency of 257.3 MC is referenced in the ICD, but not in the PIRD. Since the PIRD is presently under revision and may be issued as a PSRD, this incompatibility may be resolved in the new document.

ICD Activity Pending

1. A revision to the S/C-L/V ICD No. 13M62011 were not available; thus certain of the above comments may not be valid.

2. The following ICD's are identified* and to be submitted by the Panel in the immediate future:

   a. Apollo/Saturn EMC Design Criteria

   b. L/V-S/V to Ground Facility Interface

General Conclusions

The content and coverage of inter-Center interface documentation, by the Instrumentation/Communications Panel, when

*ICD's identified on August 3, 1965, per telephone conversation with H. Golden, MSFC Panel Co-Chairman.

combined with other Program documents (PIRD's, EIRD's, etc.), is in general compliance with the definition of inter-Center ICD's as defined in this review. Deviations from this guideline have been noted in the frequency analysis document, ICD No. 13M60002, which is identified as a historical document only and does not uniquely present data which will affect the design of equipment or facilities. In addition, the S/C to L/V ICD No. 13M62011 contains informational and procedural data, and conforms to the initial definition of ICD's which accepts procedural agreements as ICD material.

ICD's identified by the I/C Panel* contain significant new material as compared to those available during our April 1965 review. The trend of the Panel's effort in identification and documentation of interfaces is towards improvement of coverage and quality of ICD's.

Based upon the current trend of I/C Panel documentation efforts, and comparing their output against the definition of ICD's presented herein, satisfactory documentation of AS-500 series interfaces can be expected. It should be noted that possible conflict could occur between I/C ICD's and Electrical Panel agreements, PIRD's, EIRD's, and contractor documentation if rigid change control is not practiced.

*ICD's identified on August 3, 1965, per telephone conversation with H. Golden, MSFC Panel Co-Chairman.

MECHANICAL PANEL

Scope of ICD Content

The ICD's generated by this Panel should:

1. Define and resolve mechanical interface problems between launch vehicle and spacecraft and between L/V mechanical GSE and S/C GSE.

2. Define and resolve S/C to L/V mechanical and procedural interface problems associated with mating, checkout, materials, propellants, fluids, gases, environmental conditioning, alignment, servicing and access.

3. Define and resolve overall space vehicle configuration interface problems associated with structural design loads and structural problems imposed on either the S/C or L/V, including those of abort propulsion and inflight venting and internal acoustic and vibration induced environments.

Comments on Released ICD's

The comments on Mechanical Integration Panel ICD's are based on review of the documents on hand. Where appropriate, these are followed by comments that resulted from a recent telephone conversation with the MSC Panel Co-Chairman.

ICD No. 13M00308, "IU to Spacecraft Human Factors Requirements".

It seems that use of flammable and toxic chemicals should be forbidden in the area during the integration process. Also, ventilation of this area may be advisable during the integration of the Booster and Spacecraft. These may be considered operational and having no direct effect on the design, but the ICD should at least reference the document where these prohibitions would be listed. According to MSC, these precautions are being covered in an internal KSC operational document.

ICD No. 13M02308, "IU to Spacecraft Procedural Requirements".

1. In Paragraph 3.1 the torquing sequence and values are specified. However, the bolts to be used are not described in any of the IU-Spacecraft interface documents. The bolts and supplier have now been specified according to MSC.

2. In Paragraph 3.3 it is stated that the "mating of electrical connectors shall not be performed as part of procedural requirements pertaining to mechanical assembly." The document that controls this procedure should be referenced here. MSC stated that these are standard connectors and therefore no procedures need be documented and the above statement in quotations should be removed from the ICD.

ICD No. 13M06308, R-1, "IU to Spacecraft Functional Requirements".

This ICD states that the structural load requirements are to be determined. According to MSC the agreement between MSFC and MSC specifying the load requirements was signed during the week of August 23.

ICD No. 13M20108, R-1, "IU to Spacecraft Physical Requirements".

The only requirement placed on the connecting bolts is the diameter. This does not seem sufficient. Also, the organization responsible for supplying them should be spelled out. MSC has stated that the bolts and supplier have been specified.

ICD No. 13M20117, "Envelope LEM/S-IVB/IU Clearance, Physical".

The ICD would gain clarity with some explanation regarding the objects shown in phantom. According to MSC it is a policy of the Mechanical Integration Panel to keep informational material out of ICD's.

ICD No. 13M20109, R-2, "Spacecraft to Q-Ball Physical Requirements".

The procedure for installing the Q-Ball alignment ring and the alignment ring supplier should be specified. MSC stated that the procedures for using the ring are internal to MSFC and that MSFC should be designated as the alignment ring supplier.

ICD No. 13M50108, "IU to Spacecraft Physical Requirements".

As in the corresponding AS-201 ICD, the only requirements placed on the bolts is the diameter. This description seems insufficient, and the organization responsible for providing them should be designated. MSC has indicated that the bolts and supplier have been specified.

ICD No. 13M50112, "Spacecraft to Q-Ball Physical Requirements".

The method of using the Q-Ball alignment ring and the organization responsible for supplying the ring should be documented in the ICD. MSC stated that the procedures for using the ring are internal to MSFC and that MSFC should be designated as the alignment ring supplier.

ICD No. 13M50123, "Envelope LEM/S-IVB/IU Clearance, Physical".

The ICD would gain clarity with some explanation regarding the objects shown in phantom. According to MSC it is the policy of the Mechanical Integration Panel to keep informational material that is out of ICD's.

ICD Revisions

Seven IRN's associated with the above ICD's have not been examined because the June 28 request to the Repository for them has not been honored.

ICD Activity Pending

No activity is pending. However, in the week of August 23, the agreement between the MSC/MSFC Flight Mechanics and Mechanical Integration Panels establishing the information to be included in the Mechanical ICD to determine the Structural load requirements was signed.

General Conclusions

The available Mechanical Integration Panel ICD's do not cover the material as per the ICD definition in Attachment A and do not contain nonessential information. Also, some inter-Center agreements now deleted needed to be included.

Since the Bellcomm ICD review of April 1965, the ICD's examined included a modest amount of new material in the form of an IRN and showed an improvement in quality.

Information obtained from the MSC Panel Co-Chairman in a telephone conversation August 28 revealed that the coverage and quality discrepancies of the ICD's are being rectified so both the AS-201 and AS-501 ICD's generated by the Mechanical Integration Panel should show substantial improvement.